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The Nuclear Power Deception

Summary and Recommendations

The global threats arising from nuclear power and large-scale fossil fuel use stem from a common failing in the political and economic structure of decision-making. Whether one considers plutonium or carbon dioxide emissions, there has been a consistent failure to ask and pursue vigorously the answers to a few simple questions before large-scale deployment of new technologies: Is there a potential for irreversible catastrophic damage if the system does not work? What is the fate of the most dangerous materials? How many generations could be affected

One likely reason for the failure to pursue the answers even when the questions were asked is that power and money lay in the direction of development of these technologies, while the common good lay in the answers to the questions about damage to the Earth's ecosystems and to global security. But if we do not answer such questions, then it is possible that wide-ranging, potentially irreversible effects will damage the common good now and for uncountable generations into the future, even as individuals derive transient benefits from the technologies. This study examines nuclear power technology with such questions in mind.

A. Main Findings

1. There was no scientific or engineering foundation for the claims made in the 1940s and 1950s that nuclear power would be so cheap that it would lead the way to a world of unprecedented material abundance. On the contrary, official studies of the time were pessimistic about the economic viability of nuclear power, in stark contrast to many official public statements.

Unduly optimistic official public pronouncements regarding the promise of nuclear energy are epitomized by AEC Chairman Lewis Strauss's forecast for an atomic age of peace and plenty in a 1954 speech, in which he also made his well-remembered remark:

> It is not too much to expect that our children
> will enjoy in their homes electrical energy too cheap to meter....3

Our review of technical studies on nuclear power prepared in the 1940s and 1950s by a variety of government and industry sources, including the Atomic Energy Commission, revealed no evaluation of nuclear energy that concluded that nuclear energy would be cheap in the near future. On the contrary, many studies concluded that nuclear power would be more expensive than coal-fired electric generating stations and that it would have to be subsidized by military plutonium production in order to be economically viable. Other studies concluded that nuclear electricity might one day be competitive with coal, especially if coal prices rose and nuclear fuel were cheap.

A 1948 AEC report to Congress cautioned against "unwarranted optimism" about nuclear power because there were many "technical difficulties" facing it that would require time to overcome.4 The report's authors included many of the leading nuclear scientists of the time, including Enrico Fermi, Glenn Seaborg, and J.R. Oppenheimer. As another example, an industry report done by four industry-utility groups, including Bechtel, Monsanto, Dow Chemical, Pacific Gas and Electric, Detroit Edison, and Commonwealth Edison, concluded in 1953 that "no reactor could be constructed in the very near future which would be economic on the basis of power generation alone."5 Ward Davidson, a research engineer with Consolidated Edison, one of the country's largest utilities, laid out in 1950 the technical difficulties facing practical nuclear power in considerable detail, including problems such as making durable materials of assured quality that could survive the intense neutron bombardment in nuclear reactors. Insiders even scorned those who might suggest that nuclear energy would usher in an era of plenty, as noted by C.G. Suits, a General Electric Vice-President, in December 1950:

> It is safe to say...that atomic power is *not* the means by which man will for the first time emancipate himself economically....Loud guffaws could be heard from some of the laboratories working on this problem if anyone should in an unfortunate moment refer to the atom as the means for throwing off man's mantle of toil. It is certainly not that!...This is expensive power, not cheap power as the public has been led to believe.6

2. Cold War propaganda rather than economic reasoning was a driving force behind the rush to build a commercial nuclear power plant in the United States.

Coal was plentiful in the United States, then as now. Further, there were no serious pressures in the 1950s to reduce its use due to the build-up of greenhouse gases. There was therefore no urgent reason then to press ahead with building large nuclear power plants.

Despite the pessimism of governmental as well as corporate studies about its economics, nuclear electricity was seen by many in government as a key technology to be exploited in the Cold War with the Soviet Union. Atomic Energy Commissioner Thomas Murray said in 1953 that peaceful applications of the power of the atom "increases the propaganda capital" of the U.S. relative to the Soviet Union.7

The Chairman of the Congressional Joint Committee on Atomic Energy warned in 1953 that "the relations of the United States with every other country in world could be seriously damaged if Russia were to build an atomic power station for peacetime use ahead of us. The possibility that Russia might demonstrate her 'peaceful' intentions in the field of atomic energy while we are still concentrating on atomic weapons, could be a major blow to our position in the world."8 President Eisenhower's 1953 "Atoms for Peace" speech was perhaps the centerpiece of the U.S. effort to cast its nuclear program in a peaceful light for the purposes of Cold War propaganda.

The choice of the light water reactor (LWR) as the first commercial reactor was influenced by these Cold War considerations. H.C. Ott of the AEC's division of reactor development objected to the selection of the pressurized water reactor (PWR) in 1953 because the choice had not been justified "as a logical part of the over-all reactor development program and no arguments are advanced to support the thesis that a prototype power plant should be built."9 But a classified 1954 AEC report concluded that the PWR had the best short-term prospects. However, the design was considered a poor long-term choice because it was (erroneously) thought at the time that the scarcity of uranium would make reactors like PWRs uneconomical because they were net consumers of fissile material. The actual vulnerabilities turned out to be not uranium-235 scarcity, but safety, capital cost, and proliferation.

Solar energy was not pursued seriously despite a 1952 report of a presidential commission (the Paley Commission) that anticipated oil shortages in the 1970s. The report was relatively pessimistic about nuclear energy and called for "aggressive research in the whole field of solar energy -- an effort in which the United States could make an immense contribution to the welfare of the world."10 This advice was ignored. Solar energy research and development could not provide the Cold War "propaganda capital" that nuclear power gave to the U.S.

3. The AEC overruled some of its own personnel and the official Advisory Committee on Reactor Safeguards (ACRS) in its rush to build large scale power plants that would feed electricity into utility grids.

The dangers of nuclear power plants were well enough understood in the 1950s that there were many voices advising against a rush to build large scale plants. As early as the mid-1950s, the ACRS advised the AEC to proceed more slowly and cautiously with its licensing of a sodium-cooled breeder reactor, Fermi I, near Detroit. Autoworkers' unions went all the way to the Supreme Court to try to block its construction, but they failed. A pilot plant of similar design, the Experimental Breeder Reactor I built in Idaho, had had an accident in 1955 during a safety experiment. The voices of caution did not prevail. The Fermi I reactor was started up in 1963, but had not yet achieved full power when it suffered a partial meltdown due to a partial cooling system blockage in 1966.

The ACRS also had concerns regarding unresolved issues surrounding a potential meltdown of the core of light water reactors (LWRs) in case of a loss-of-coolant accident. Its concerns received heightened attention only after protracted hearings in the early 1970s on the issue in which independent scientists, notably from the Union of Concerned Scientists, and whistleblowers played central roles.

Finally, in 1957, an official study by Brookhaven National Laboratory concluded that up to 3,400 people could die and up to 43,000 people could be injured in case of a severe accident in a 500 megawatt-thermal (100 to 200 megawatt-electrical) nuclear power plant. Property damage alone was estimated at up to $7 billion in 1957 dollars (about $38 billion in 1995 dollars). Many power reactor safety studies and experiments were begun in the 1950s, but they were not completed before commercial reactors started being built in large numbers. Instead the government provided industry with a huge subsidy in the form of the Price-Anderson Act, which limited their liability to $500 million above "private insurance." Self-insurance was permitted as a form of private insurance under the Act. The total compensation was therefore considerably less than 10 percent of the estimate in WASH-740 of property damage alone.

The potentially catastrophic nature of nuclear accidents was made painfully graphic by the Chernobyl accident. The amount of damage from a catastrophic accident on the scale of Chernobyl vastly exceeds the $7 billion insurance provision in the 1988 amendment to the Price-Anderson Act.

4. Every major reactor design that was adopted had and continues to have crucial unresolved safety vulnerabilities as a result of the rush of the nuclear weapons states to deploy nuclear power plants well before the technology had been properly investigated and developed.

The three major reactor designs of the 1950s were:

- Water-cooled and water-moderated reactors
- Graphite-moderated reactors (gas-cooled or water-cooled)
- Sodium-cooled fast neutron reactors (also called breeder reactors).

The basic safety flaws of these designs were identified in the 1950s and 1960s. Yet, nuclear establishments (governmental and private) persisted with these designs because they had already made heavy investments in them. One initial AEC response to safety problems as they were revealed was to try to suppress discussion. But in the United States, where the public's right to know is greater than in any other major nuclear state, many safety issues did become public. The official response in such cases was to try to deal with safety issues in an *ad hoc* and dilatory manner. When that route became too cumbersome and bred lawsuits, the AEC held a rule-making hearing on the most important kind of accident identified for LWRs -- the loss-of-coolant accident. The hearings revealed serious problems, official attempts to cover them up, and safety issues that had not yet been satisfactorily resolved. All this resulted in a loss of public confidence and higher costs in the long-run due to retroactive safety requirements that were needed.

Basic safety issues have not been resolved in that the potential for catastrophic accidents remains. For instance, then-NRC Commissioner James Asselstine, noted in 1986 that "given the present level of safety being achieved by the operating nuclear powerplants in this country, we can expect to see a core meltdown accident within the next 20 years, and it is possible that such an accident could result in off-site releases of radiation which are as large as, or larger than, the releases estimated to have occurred at Chernobyl."11

Newer versions of the light water reactors in the United States and elsewhere have not eliminated the danger arising from a loss-of-coolant accident. Similarly, safety vulnerabilities continue to exist in other reactor designs that are being advertised as "inherently safe," such as a gas-cooled, graphite moderated reactor. This is a public relations phrase that applies to avoiding or minimizing risks from particular types of accidents, notably loss-of-coolant accidents. Other accidents types, also potentially catastrophic, may occur with such designs.

There is an even greater danger of a severe accident in the former Soviet Union, due to relatively less safe designs (including lack of secondary containment) and poorer maintenance due to the economic collapse that has taken place at the end of the 1980s. According to Michael Golay, a professor in the nuclear engineering department of the Massachusetts Institute of Technology, there is "a very high likelihood of a serious reactor accident in the near future" in the former Soviet Union and Eastern Europe due to the relatively unsafe reactor designs, poor reactor system construction materials, and other factors, such as low spending on maintenance.12

5. Nuclear power became established in the market place at a low price in the 1960s as a result of government subsidies, lack of adequate attention to safety systems, and an early decision by manufacturers to take heavy losses on initial orders. Costs increased when these advantages were reduced.

Direct government subsidies helped finance reactors until 1962. After that G.E. and Westinghouse decided to market LWR technology at a loss because they feared it would otherwise become obsolete.

A General Electric vice-president later stated that "If we couldn't get orders out of the utility industry, with every tick of the clock it became progressively more likely that some competing technology would be developed that would supersede the economic viability of our own. Our people understood this was a game of massive stakes and that if we didn't force the utility industry to put those stations on line, we'd end up with nothing."13

About 45 percent of the entire eventual installed nuclear capacity of about 100,000 MWe in the United States was ordered in the four-year period between 1963 and 1967. There was a rush of reactor orders and nuclear power plant completions. The power plants were built with government-subsidized insurance and without practical assurance that critical safety systems would work.

Several factors led to nuclear power costs increasing rapidly in the 1970s and early 1980s:

- Manufacturers stopped offering the plants at large losses.
- Government subsidies (other than accident insurance under the Price-Anderson Act) disappeared.
- The AEC imposed new safety requirements.
- Interest rates rose dramatically in 1979 and stayed relatively high for over a decade.

As a result of these factors, nuclear power costs rose very rapidly. At the same time electricity growth rates declined. As the 1980s wore on, nuclear power plant operating, maintenance, and fuel costs rose to above those for coal-fired plants, as did estimates for reactor decommissioning. As a result, the loss of public confidence in nuclear power spread from Main Street to Wall Street. The disillusionment was the result of promises on cost that could not be fulfilled, a poor approach to safety that ignored or downplayed early warnings, and attempted cover-ups of safety issues that were later exposed. The Three Mile Island accident was the perhaps the knock-out punch on safety issues. While the releases of radioactivity were not high (relative to other severe nuclear accidents), it showed that core meltdown accidents could happen and that accident probabilities may not be as low as had been supposed. Public disillusionment with nuclear power was reinforced by a corresponding loss of trust on nuclear weapons-related environmental mismanagement and misrepresentations.

6. The non-proliferation issues related to nuclear power, and in particular their relation to the arsenals of the existing nuclear weapons states, have never been satisfactorily resolved.

Nuclear power is vulnerable to forces of social instability and violence, which are becoming more technologically sophisticated while crucial institutional mechanisms for holding them in check remain weak. Examples range from the bombing in Oklahoma City to the gas attack on the Tokyo subway to threats of radioactive warfare made by Chechen rebels.

A second proliferation vulnerability of nuclear power is the vast amount of plutonium created in nuclear power plants. Every four years or so commercial nuclear power reactors create an amount of plutonium equal to that in the global military stockpile. This plutonium is not usable for weapons unless the spent reactor fuel is reprocessed (that is, unless the plutonium is separated from fission products and residual uranium). A large amount of plutonium has already been separated. Commercial reprocessing plants are operating in France, Britain, Japan, Russia, and India. Proposals exist for reproecessing U.S. spent fuel more (see below).

7. Management of spent nuclear fuel has become a central concern regarding nuclear power growth.

The problem of high level nuclear waste has not been resolved anywhere in the world, after four decades of nuclear electricity generation. The early confidence that nuclear scientists would somehow solve the waste problem, just as they had built the atom bomb, has evaporated

In the United States, sound science has been overtaken by political considerations in the rush to relieve utilities of the liabilities deriving from the spent fuel accumulating at reactor sites. The Yucca Mountain site is the only one under investigation. Yet calculations done for this site, including those by Department of Energy contractors, indicate that radiation doses could be hundreds or even thousands of times above presently allowable limits. There is pressure to relax standards and change calculation methods instead of improving the repository program.

8. Reprocessing, which is the separation of plutonium and uranium from used reactor fuel is a costly, dangerous, and proliferation-prone technology. Yet political pressure is building to reprocess spent fuel as a waste management method.

Reprocessing is very costly. The overall costs of this approach to spent fuel management and disposal would range from roughly $130 billion for government-subsidized reprocessing to $250 billion for commercial reprocessing in which the customer pays the full costs. This translates into half-a-cent to one cent per kilowatt hour of nuclear electricity -- five to ten times more than the contribution of 0.1 cent per kilowatt hour (electrical) that nuclear utilities are now required to make by law into a nuclear waste fund. This presumes commercial reprocessing in a new reprocessing plant in the United States.

The safety and environmental consequences of using existing U.S. military reprocessing plants, which are over 40 years old, are incalculable. As a result the costs are also highly uncertain. Reprocessing in existing military plants would greatly exacerbate high-level waste management problems, already beset by risks of fires and explosions.

Commercial reprocessing in France, Britain, Japan, Russia, and India is now the most important contributor by far to the growth of nuclear weapons-usable plutonium in the world. As the only nuclear weapons state not reprocessing for military or commercial reasons, the U.S. is the one country with the political standing to persuade Russia and other countries to stop commercial reprocessing. Reprocessing U.S. commercial spent fuel in the United States (or abroad) would be a grave practical setback to the implementation of the U.S. non-proliferation policy of discouraging reprocessing and the growth of weapons-usable materials stocks.

Yet, the political pressure from the U.S. nuclear power industry is causing proposals for reprocessing this commercial spent fuel to reemerge in a way not seen since the early days of the Reagan administration. One such proposal was put forward by Westinghouse in an August 1995 study done for the DOE. This is a dangerous trend. It is difficult to overemphasize the central importance of U.S. policy against commercial reprocessing.

9. The problem of what to do with the surplus plutonium in U.S. and Russian military stockpiles is exacerbating a growing commercial plutonium surplus.

Proposals have been put forward to convert plutonium into mixed uranium-plutonium oxide fuel (called MOX fuel) in order to use it in existing commercial reactors or in new reactors. Such use would create a new commercial-military link that seems in many ways like a replay of the earlier debates on dual-use reactors. However, this time around, the civilian reactors are proposed to be used to partially destroy (or "burn") rather than create military plutonium. Such a connection would be undesirable for a number of reasons, not least of which are the proliferation implications of establishing a plutonium fuel economy in the United States.

10. Nuclear power plants cannot simultaneously meet stringent safety criteria that would rule out catastrophic Chernobyl-like accidents and also contribute significanty to the reduction of greenhouse gas emissions in a timely manner.

In order to ensure that nuclear reactors are not vulnerable to catastrophic accidents, new designs would need to be developed. These designs would have to be thoroughly checked on paper and in experimental and pilot-scale reactors before relatively large plants were built. Such an effort to ensure reactor safety and regain public confidence would take decades, if it can be accomplished at all. However, carbon dioxide emissions must be reduced in the same period. The next few decades will be crucial in the effort to minimize the threat of disastrous adverse effects due to the build-up of greenhouse gases. As a result, nuclear power plants cannot simultaneously meet stringent safety criteria that would rule out catastrophic Chernobyl-like accidents and also contribute significantly to alleviating the greenhouse gas build up.

11. It is possible to simultaneously phase out nuclear power plants and reduce carbon dioxide emissions from fossil fuel burning.

The low efficiency of primary fuel use even in technologically advanced countries and the even lower efficiencies in the rest of the world means that much or most of the increased energy needs of the world's people can be met by improving efficiency dramatically. Renewable energy sources and judicious use of natural gas technologies can displace both nuclear power plants and help reduce the use of oil and coal in electricity generation. Technologies for greatly increasing energy efficiency as well as for using renewable energy sources are available now. Many others are nearly commercial. Institutional and market failures as well as the lack of proper government procurement policies and regulations are systematically hindering the widespread use of these technologies.

B. Recommendations

The central recommendation of this study is that nuclear power should be phased out. Specifically:

1. Existing nuclear power plants should be phased out as they come to the end of their licensed lives, or earlier if that is compatible with or needed for the security and safety of power supply.
2. New nuclear power plants should not be built in the foreseeable future.
3. The phase out of nuclear power should be accomplished simultaneously with a reduction in emissions of carbon dioxide from fossil fuel use by greatly increasing energy efficiency, moving to renewable sources of energy as the primary energy supply, and using natural gas judiciously. The "Atoms for Peace" program, which is a dangerous relic of the Cold War, should be replaced by a global "Energy for Peace" program that stresses renewables and energy efficiency.14
4. Increasing the efficiency of energy use and increasing generation of electricity from renewables should be accomplished by policies such as:
    - Requiring developers of new buildings and factories to contribute to an electricity capital fund corresponding to the demand their project makes on the electricity grid.
    - Enacting procurement policies by which governments and utilities would acquire electricity generated from renewable energy sources in order to encourage the development and widespread use of these technologies.
    - Creating a "just-in-time" systems for investments in small-scale co-generation plants, small and medium-scale renewable energy power plants, and energy efficiency so as to reduce the average amount of idle capacity.

Other Recommendations

1. Surplus plutonium should be vitrified rather than used as a reactor fuel either by itself or in combination with uranium. No infrastructure for use of mixed oxide fuel should be created. Proposals to burn plutonium in existing commercial reactors or to produce military tritium in them should be scrapped.
2. Because military involvement in the development of commercial nuclear power has encouraged poor energy choices from the perspective of civilian power needs, this course should not be repeated. In particular, the DOE should halt any further consideration of

building a new dual-purpose production reactor which would both produce tritium for bombs and commercial electricity or a "triple play" reactor which would burn excess weapons plutonium in addition to these two functions. All expenditures for research and development along these lines should be stopped.

3. Industry must accept the financial risks of possible failure. This includes an end to federally established liability limits embodied in the Price-Anderson law for new nuclear power plants. Further, the government should collect fees for insurance for existing power plants that correspond to damage assessments that take into account the scale of harm inflicted by the Chernobyl accident.
4. Maintenance of a knowledge base regarding nuclear technology is important for a number of reasons, including medical and research uses, improving reactor safety so long as power reactors are in operation, and study of long-term waste management. This function should be performed openly by universities and other public and private research centers that are not connected to the secrecy prevailing in nuclear weapons establishments.
5. Management of spent fuel and weapons-usable fissile materials involves such momentous and unprecedented security and environmental issues over so many generations that it must be done in the most democratic, scientifically thorough manner of which society is capable. Management of wastes that already exists should be distinguished from waste that would be produced by new nuclear power plants. The government should not agree to simply take over the liabilities of nuclear waste from new plants.

The policies needed to restructure the existing waste management program are discussed in our earlier book on nuclear waste, *High-Level Dollars, Low-Level Sense.* We merely summarize those recommendations and update them here:

- Reclassify waste by longevity and hazard.
- Cancel the Yucca Mountain repository program.
- Give due consideration to the historical claims of Native Americans to the land upon which Yucca Mountain is situated.
- Create on-site storage with adequate vigilance regarding safety of construction, siting issues, and electricity requirements, in the context of local public utility commission proceedings, as an interim measure while the long-term management program is restructured.
- Rule out reprocessing as a waste management option.
- Focus the long-term management program on the scientific issues that must be understood. Examples are:
  - Study of natural conditions in which radioactivity does not migrate
  - Creation of engineered barriers to mimic natural materials that retard radionuclide migration
  - Development of methods to reduce uncertainties regarding impact on the human environment in the long-term
  - Assessment of non-repository options such as sub-seabed disposal or disposal deep within the Earth's crust (which extends down to about 40 kilometers below the surface).

- Give the responsibility for long-term nuclear waste management to a new institution that is free of the conflict-of-interest that pervades the present program. DOE has been a major generator of high-level waste and is at the same time responsible for repository site characterization and selection.